DRAFT Midway Atoll NWR Seawall Repair Project – Coral Mitigation and Translocation Plan

The U.S. Fish and Wildlife Service (Service) and the Federal Aviation Administration (FAA) propose to replace sections of Sand Island's approximate 5,720-foot south seawall, as needed, to protect Henderson Field and to control erosion of wildlife habitat. The Service and the FAA have proposed a ten-year period for repairs, as funding is made available.

Seawall repairs would be constructed by replacing damaged sheet pile with armor rock revetment. Revetments would consist of large (2- to 3-ft diameter) armor rock placed over smaller underlayer rocks. The cumulative footprint of the "Maximum Construction Scenario" includes the footprint of all rock revetment that could be installed along the 5,720 linear ft. seawall. The total footprint would be approximately 100 ft. wide, with approximately 50 ft. of rock being placed within marine waters (6.6 acres) and a 50-ft. construction footprint on uplands adjacent to the seawall (6.6 acres) for a total area of 13.2 acres.

Previous Repair Activities and Transplantation Effort

At the request of the Service's Midway Atoll National Wildlife Refuge (NWR), the National Oceanic Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) prepared an Essential Fish Habitat (EFH) consultation for a project to repair a section of the seawall adjacent to Henderson Field at Midway Atoll NWR. The proposed repair was scheduled for the summer of 2014. NMFS reviewed the results of the August 8, 2013, biological survey conducted by Service's Ecological Services biologists, and provided conservation recommendations to ensure that any adverse effects as a result of the project to coral reef resources and EFH at Midway are avoided, minimized, or offset. The results of the consultation were communicated to the Service via a letter from Gerry Davis, NMFS Assistant Regional Administrator for the Habitat Conservation Division on October 9, 2013. Included in the recommendations were that Midway Atoll NWR should:

1. Relocate, prior to the start of construction, the coral and macroinvertebrates present within the project area that will be damaged by construction (both in the direct fill footprint and adjacent to this if appropriate) to an area outside of the project footprint. When selecting a relocation site the applicant should consider a site away from the length of the seawall since it is likely that the rest of the seawall will require repair in the next several years. Establish a monitoring protocol for corals post move to determine the effects of transplantation on the survival and growth of the transplanted organisms. NMFS can assist in developing a practicable transplantation plan.
2. Post-construction, provide information on the species, size and the total amount of any corals impacted from the salvage operations. Offset this resource loss, including the loss

of approximately 0.04 acres of EFH bottom habitat. If the overall unavoidable loss is minimal, NMFS would support mitigation offset involving removal of long-standing un-colonized debris in areas adjacent to the project fill footprint to future damage to the corals and marine resources in the area. Other compensatory mitigation alternatives may also be appropriate.

3. Consider the cumulative impacts on EFH, and the likely compensatory mitigation requirements, involved in any future repairs. A relatively small amount, 0.04 acres, of EFH bottom habitat will be lost due to the proposed repair of approximately 90 feet of sheet pile. If the proposed repair method (rock revetment) is used along the entire 1,425 feet of sheet pile that protects the Henderson Field runway, there would be a corresponding loss of 0.63 acres of EFH.

For the seawall repair that occurred in 2014, 36 corals were relocated from a 0.04 acre area of seawall near Henderson Field to Reef Hotel on the north end of the atoll in June 2014. Unfortunately this transplantation had low survival rates due to several reasons, one being the El Niño and warm water event that caused coral bleaching throughout the atoll (NOAA Coral Reef Watch 2014), and others due to the transplantation methods themselves. The corals were removed from the project area and placed in holding tanks where they were epoxied to blocks, and then transported to the northern end of the atoll, to the Reef Hotel site (Figure 1). The corals were then placed out onto inadequate substrate and were subsequently washed around during storm events and buried by sand (USFWS 2016). The remoteness of the Reef Hotel site and the distance from camp made monitoring of the transplanted corals difficult for the small staff present on Midway. The translocation site was not a suitable one, and for the upcoming projects we will use a different site in order to reduce mortality through site selection and monitoring.

Current Biological Evaluation

As part of the Environmental Assessment process, the Service's Ecological Services biologists documented coral colonies and species observed along the southern coastline of Sand Island in the 6.6 acre project footprint, plus an additional buffer that could potentially be impacted by construction activities (USFWS 2016). There were 373 coral colonies observed on 26 random data transects in the entire survey area, all measuring less than 80cm (Table 1). Nine species from four families were recorded, with lobate, encrusting, and branching morphologies present. These species were found in mostly low densities (<one colony per m^2) and had a maximum diameter of approximately 50cm. This was a small sample of the colonies present. Additional species and larger colonies may be present in areas not covered by the limited number of benthic and vertical transects. The transects were divided in benthic and vertical (sheet pile) directions so that both dimensions that would be lost would be captured. The density of colonies observed was not uniform across the 26 random transects, with some areas having higher observations than others, and some areas having no observations of coral colonies present.

New Repair Activities and Transplantation Effort

At the time of the development of this document (April 2017), the 2013 EFH recommendations were used as guidance. EFH recommendations will be provided for the new programmatic permit at the completion of the Draft Environment Assessment. NMFS/PIRO and the Service's Ecological Services have been involved with the planning process and have provided input into this document. For the continued repair of the seawall on the programmatic scale, the Midway Atoll NWR agrees to conduct the following actions to address the recommendations.

1. Coral Relocation

   To address the first recommendation, the Pacific Islands Refuges and Monuments Office staff will implement a coral transplantation project to remove corals in the project footprint and relocate them to a suitable recipient site. The coral transplantation efforts will occur prior to each section of seawall repair. Coral colonies will be moved from each proposed repair section, as funds become available to repair those sections.

   The Service staff must be conscious of the time required to perform transplantations as well as the time needed for future monitoring of transplants. With a project area of approximately 6.6 acres for the long-term repair project, there will be coral colonies of various sizes in various sections of the project area. Each transplantation effort will vary based on the number and morphology of coral colonies present, as well as their location, benthic or vertical.

   Transplant success for corals can be low even in controlled experiments (Yap et al. 1992; Piniak and Brown 2008) as well as in the field (Kolinski 2006). Different coral genus, species, and size classes can show differential success and survival (Kolinski 2006; Jeansonne 2002; Jokiel et al. 1999; Jokiel et al. 2006). Mortality can result from storms, sedimentation, grazing, algae, temperature extremes, or damage during the transplant process. Corals in the genus *Pocillopora* have been shown in both the lab and the field to be more susceptible to thermal stress due to their higher metabolic rates (Mayer 1914, Coles et al. 1974). In Kona 7500kg of corals of various species were transplanted and showed 100% survival after 4 months, showing that the transplantation was a success (Jokiel et al. 1999). A severe storm in the winter of the transplantation year, dislodged and buried many of the transplants, and the remaining transplants declined over time due to fish grazing, sedimentation, abrasion, bleaching and algal over growth (Jokiel et al. 1999). The transplantation of 354 corals in the genus *Porities*, *Pocillopora*, and *Montipora* occurred in American Samoa following two ship groundings. One year after transplantation 97% of the transplanted corals were relocated, with an overall tissue

DRAFT

survival of 66% (Jeansonne 2002). Another transplantation project in American Samoa saw high (91 to 92%) transplant survival approximately one year following reattachment in 2001; however, by 2005 survival (60 to 78%) had declined significantly (Kolinski 2006). Lobate *Porites* species and *Pocillopora eydouxi* had significantly higher survival rates than small and mid-sized *Pocillopora* species (Kolinski 2006).

All suitable coral colonies will be removed from the vertical sheet pile, the bottom substrate, as well as any submerged debris that must be moved for the construction to occur. Corals that are not moved will become unavoidable loss requiring a suitable offset. Debris may include rip-rap, large boulders/stones, and miscellaneous trash dumped over the seawall. Where possible smaller corals will be transplanted and cemented into place on suitable substrate seaward from the repair site and away from any potential future seawall repair work. This area will be well outside of the work area footprint, and will allow for a dispersion of the translocate corals into two different areas with slightly different environmental factors.

Methods

The shallow area of the project will be accessed via the shore, while the deeper area (<2 m) will be accessed via a small boat. The project foot print will be surveyed to get an estimate of the number of corals that need to be translocated. Three areas to the south of the sea wall has been identified as potential transplant sites (Figure 4). These areas have been categorized by the NOAA Atlas of Shallow-Water Benthic Habitats of the Northwestern Hawaiian Islands as both uncolonized hardbottom, and uncolonized linear reef (NOAA 2003). The sites are approximately 450 ft. to over 1000 ft. from the sea wall, and well outside of the project foot print (Figure 4). Since the sites are somewhat close to the seawall, while remaining a safe distance away from the project area, the hope is that these sites will share many of the same environmental conditions as the harvest site. Transplant areas will be scouted prior to removing corals from the seawall and the substrate prepared for coral transplantation. Suitable transplant sites will be selected and marked with temporary markers, and the substrate at these sites will be cleaned with a wire brush to remove all macro and turf algae.

Colony collection will be accomplished by personnel working in pairs using snorkel, and/or SCUBA. The corals will be removed from the seawall by hand or chiseled to separate them from the substrate and placed into a bucket. If a coral is attached to a removable rock or rubble, the rock will be relocated with the coral intact. This will serve to reduce the mortality associated with breaking the coral and subsequently reattaching it to another rock at the translocation site.

DRAFT

To minimize potential impacts due to handling the corals, they will be transplanted the same day as harvest. The coral will be attached to the recipient site using Portland Type 2 Cement or Splash Zone marine epoxy. Once the corals have been removed from the work area they will be handed to a snorkeler or diver, placed in a bucket and either swum or driven by boat to the translocation site. There the snorkeler/diver will place corals in clusters of several colonies and the clusters will be approximately 1 m apart along a transect. A cow ear tag will be attached to the substrate adjacent to each transplanted coral and GPS coordinates will be recorded at the beginning and end of the transect, as well as at each transplant cluster site. Photos will be taken of all of the transplanted corals with their corresponding tag numbers, and a scale bar for reference. Each tagged coral colony will be identified to species where possible, the diameter measured, and any existing mortality recorded.

2. Post construction Monitoring

A critical part of the process is the monitoring or transplanted corals to determine the survival and success of the relocation effort. For this coral mitigation effort, a 50% survival rate is proposed as the minimum measurement of success at each recipient site. Unforeseen events may contribute to a higher mortality such as a strong El Nino event, prolonged elevated sea surface temperatures leading to corals bleaching, or a severe storm event. A control site will be identified during the first translocation. The site will be comparable to the transplant site in as many environmental factors as possible. Corals at the control site will be surveyed, and several will be marked with numbered cow ear tags as above, photographed, measured for size and any existing mortality recorded. This control/reference site will allow for the identification of coral mortality due to transplantation, or due to other unforeseen environment factors or natural disasters such as sever storm events and elevated water temperature.

The first monitoring visit for each transplantation event will be within one week of the relocation and the corals will be inspected to confirm that they are still attached to the substrate at the translocation site. If they are not, the attachment process will be repeated. Initial baseline measurements will be made for each coral (diameter) and general comments recorded concerning the corals appearance (i.e percent alive, algae growth, signs of predation, etc.). Photos will also be taken of each coral with a ruler in frame for scale references. Photos will be compared to those taken upon transplantation, and any transplantation and handling induced stress or mortality will be documented. Subsequent monitoring will be done every three months through the first year, and then every six

DRAFT

months for the second year, at which point monitoring will cease. During each follow-up survey cow ear tags will be cleaned of biofouling to ensure they can be easily read and transplants will be groomed of fouling organisms. If tags are missing they will be replaced and the change in number noted. All coral transplant sites and tag numbers will be cross referenced, so if a tag is lost the GPS coordinates can be used to determine the tag numbers that corresponds to a specific cluster of corals. The Service will share monitoring data with NMFS and USFWS Ecological Services as requested, following each monitoring event.

The Service will not measure fecundity of the transplanted corals as part of the monitoring plan. Fecundity is hard to measure and requires histology, and knowledge of when coral spawning occurs. This is both difficult to coordinate if spawning time is unknown and invasive because it requires breaking off pieces of the corals to collect tissue for histology, and then decalcifying the fragments. Little is known about coral spawning at Midway and breaking pieces off will introduce sites for bio-eroders, and coral diseases. The intent of this project is save the corals that already exist by relocating them out of the work site, and giving them the best chance at survival. This is accomplished by transferring the corals and their ecological function to an area close to the worksite.

3. Post construction reporting

   Once a section of the seawall is repaired a post-construction report will be generated providing information on the species, size and the total number of corals transplanted on the existing revetment. Information on the species, size and the total number of corals that were negatively impacted by the salvage operation and repair of the seawall because they could not be moved or transplanted, will be reported as well.

4. Adaptive Management

   - Upon inspection corals are secure and epoxy is intact and supporting corals at the transplant site. The epoxy has a good bond and corals will not be washed off in large wave events.
   - All coral tags are clearly visible and easy to read. Will be replaced during monitoring activities, as needed.
   - GPS coordinates are taken at each cluster of transplanted corals to ensure ease of follow-up monitoring of transplanted corals

DRAFT

- Monitoring occurs within one week of transplantation and at 3 month intervals for the first year and at 6 month intervals for the second year. After which, monitoring may stop.
- Data from monitoring surveys are shared with NMFS, and PIFWO
- Success criteria will be seen as 50% survival rate of transplanted coral colonies (a maximum of 50% mortality rate). All coral mortalities (when compared to control site mortality rates) will require the FWS to provide compensatory mitigation.

In the event that colony mortality exceeds 50% at the end of Year 1, the transplantation sites and methods will be reevaluated. Areas that are nearby, with less wave action and turbidity, and are easily accessible for translocation and monitoring will be scouted that have corals present.

5. Compensatory Mitigation

For any project which may impact essential fish habitat, the preferred order of applied mitigation measures are avoid, minimize, and offset (compensation). Avoidance implies a change to the project design (i.e. alternative method) that prevents impacts from occurring. Minimization seeks to reduce the impacts from a project by carrying out some beneficial action (i.e. coral translocation)

Compensatory mitigation is designed to replace lost functions and services caused by unavoidable impacts from actions taken to complete a project. The final determination on the amount of compensatory mitigation needed to offset unavoidable adverse impacts is made by the appropriate permitting authority in accordance with applicable regulatory requirements. For example, for projects that require U.S Army Corps of Engineers authorization, final determination as to whether compensatory mitigation is required, or not, for a specific project rests with Corps.

The lost functions and services that will result from the seawall repairs will include: a net loss of 6.6 acres of essential fish habitat, the mortality of coral colonies that do not survive the relocation process, and the loss of corals that cannot be removed (encrusting corals, etc.) from the project area. A determination will have to be made on the nature of the loss of essential fish habitat, since the bottom being replaced is marginal habitat (sandy bottom) that support few coral colonies with new hard structure in the form of the stones that make-up the rock wall revetment. The net loss of coral colonies from the translocation efforts will be based on the ability of the staff performing the moves, and expressed in the data gathered during the post-move monitoring efforts.

DRAFT

The agencies involved will have to discuss the extent of the losses incurred from each action, and to identify strategies that will be used to offset those losses. Some examples of compensatory mitigation may include:

- Monetary compensation;
- Debris removal;
- Invasive species control,
- Installation of mooring buoys, and
- Erosion control.

DRAFT

References

Coles, S.L., Jokiel, P.L., and Lewis, C.R. 1976. Thermal tolerance in tropical versus subtropical Pacific reef corals. Pacific Science, 30 (2): 159-166

Garrison, V.H. and Ward, G. 2012. Storm-generated coral fragments – a viable source of transplants for reef rehabilitation. Biological Conservation, 141(12): 3089-3100.

Hogson, G. 1990. Sediment and the settlement of larvae of the reef coral *Pocillopora damicornis*. Coral Reefs, 9: 41-43.

Jeansonne, J. 2002. Coral restoration project, Pago Pago, American Samoa. Draft year one monitoring report: July 2001, NOAA Fisheries.

Jokiel, P.L., Cox, E.F., Te, F.T., and Irons, D. 1999. Mitigation of reef damaged at Kawaihae Harbor through transplantation of reef corals. Final report of cooperative agreement 14-48-0001-95801, U.S. Fish and Wildlife Servidce, Pacific Islands Ecoregion, Honolulu.

Jokiel, P. L., S. P. Kolinski, J. Naughton and J. E. Maragos. 2006. Review of coral reefrestoration and mitigation in Hawaii and the U.S.-Affiliated Pacific Islands. Pages 271-290. *In:* W. F. Precht (ed.), Coral reef restoration handbook, CRC Taylor & Francis, New York.

Kolinski, S.P. 2006. An assessment of corals five years following transplantation at Au, Tutuila, American Samoa. National Marine Fisheries ServicePacific Islands Regional Office. 11pp

Mayer, A.G. 1914. The effects of temperature on tropical marine animals. Carnegie Institute. Washington Publ. 183:3-24.

Piniak, G.A. and Brown, E.K. 2008. Growth and mortality of coral transplants (*Pocillopora damicornis*) along a range of sediment influence in Maui, Hawai'i. Pacific Science, 62(1): 39-55.

NOAA. 2003. Atlas of the shallow-water benthic habitat of the Northwestern Hawaiian Islands (Draft). 160pp.

NOAA. 2014. NOAA Coral Reef Watch -- 2014 annual summaries of thermal conditions related to coral bleaching for U.S. National Coral Reef Monitoring Program (NCRMP) jurisdictions. 16 pp.

Richmond, R.H. 1987. Energetics, competency, and long-distance dispersal of planula larvae of the coral *Pocilllopora damicornis*. Mar. Biol., 93: 527-533.

USFWS. 2016. Midway Seawall Long-Term Maintenance. Midway Atoll National Wildlife Refuge and Battle of Midway National Memorial. Planning Aid Report, Fish and Wildlife Coordination Act. Phase 1 Marine Habitat Characterization and Phase 2 Marine Biological Assessment. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 249 pp.

Veron, J.E.N. 2000. Corals of the World.

Ward, S. 1995. The effect of damage on the growth, reproduction and storage of lipids in the scleractinian coral *Pocillopora damicornis* (Linnaeus). Ecology, 187(2): 193-206.

Yap, H.T., Aliño, P.M., Gomez, E.D. 1992. Trends in growth and mortality of three coral species (Anthozoa: Scleractinia), including effects of transplantation. Mar. Ecol. Prog. Ser., 83: 91-101.

Zakai, D., Levy, O., and Chadwick-Furman, N.E. 2000. Experimental fragmentation reduces sexual reproduction output by the reef-building coral *Pocillopora damicornis*. Coral Reefs, 19: 185-188.

DRAFT

Table 1. Estimated size class distribution (cm) for all coral colonies observed along 26 stratified random transects within the proposed footprint

0 to <10	10 to <20	20 to <40	40 to <80	80 to <160	160+	Total All Colonies
162	106	101	4	0	0	373

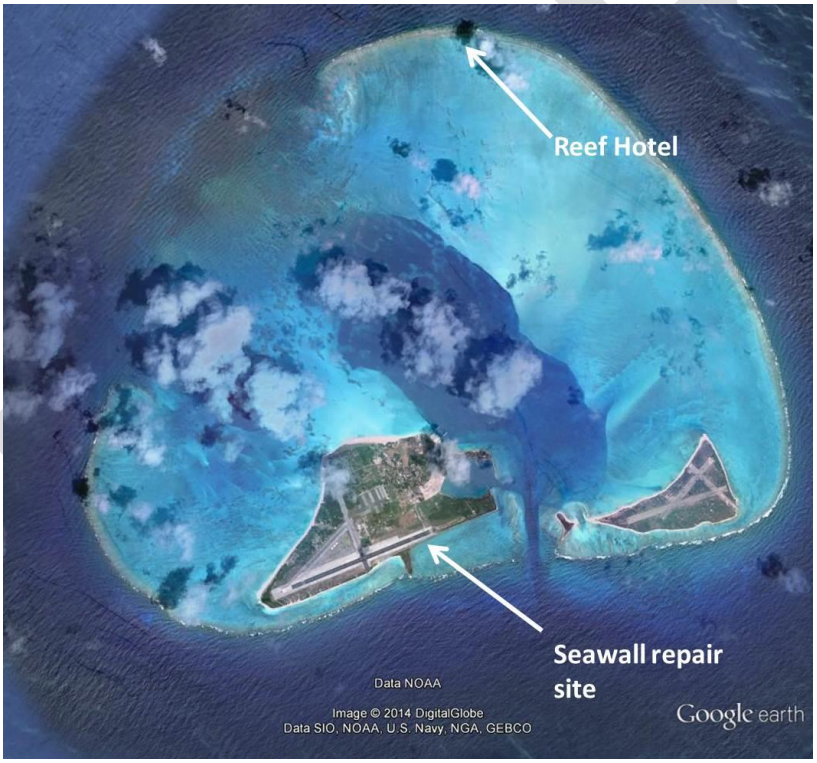

Figure 1. Midway Atoll National Wildlife Refuge. Location of seawall repair site.

Figure 2. Estimated seawall repair area at Sand Island to be covered under programmatic U.S. Army Corps of Engineers Permit. Area A includes areas adjacent to Henderson Airfield and the Runway Safety Area. Area A maintenance responsibility belongs to the FAA. Area B is the remaining portion of the existing seawall, of which the responsibility belongs to Midway NWR. A total of 5,720 linear ft.

Figure 3. Potential footprint of project impacts, including silt curtain boundary (yellow line). Sand Island, Midway Atoll NWR.

Figure 4. Potential coral transplantation locations for future seawall repairs.

DRAFT